CERTIFICATE OF TRANSLATION

I Roger P. Lewis, whose address is 42 Bird Street North, Martinsburg WV 25401, declare and state the following:

I am well acquainted with the English and Japanese languages and have in the past translated numerous English/Japanese documents of legal and/or technical content.

I hereby certify that the Japanese translation of the attached translation of documents identified as

Olympus Ref. 20-135

is to the best of my knowledge and ability true and accurate.

I further declare that all statements contained herein of our own knowledge, are true, that all statements of information and belief are believed to be true.

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[Document Name] Specifications

[Title of the Invention] Stereoscopic Microscope

Scope of Patent Claims

Claim 1

A stereoscopic microscope, comprising an illumination optical system for illuminating a luminous flux onto an observation subject from a light source member and which includes a projection optical system that forms an image one time of a luminous flux from a light source member, and an observation optical system that includes an object lens that brings the observation subject into the focal position, a left and right pair of zooming optical systems that can change the observation magnification of the observation subject and a left and right pair of eyepiece optical systems; a stereoscopic microscope is comprised by de-centering the center position of the light source member against the optical axis of the illumination optical system so that the luminous flux of the illumination optical system moves in the orthogonal direction against the horizontal plane that includes two observation optical axes of the zooming optical system.

Claim 2

A stereoscopic microscope, comprising: an observation optical system that includes an object lens that brings the observation subject into the focal position, a left and right pair of zooming optical systems that can change the observation magnification of the observation subject and a left and right pair of eyepiece optical systems; and an illumination optical system that includes a reflection member for leading the luminous flux from a light source member to the observation subject; and a stereoscopic microscope is comprised by a notch being arranged on the reflection member so that the luminous flux of the illumination optical system and the optical axis of the observation optical system can approach each other, and the notch is a shape contacting 1/3 or more of the outer diameter of the two luminous fluxes

[Document Name] Specifications

[Title of the Invention] Stereoscopic Microscope

Scope of Patent Claims

Claim 1

A stereoscopic microscope, comprising an illumination optical system for illuminating a luminous flux onto an observation subject from a light source member and which includes a projection optical system that formsan image one time of a luminous flux from a light source member, and an observation optical system that includes an object lens that brings the observation subject into the focal position, a left and right pair of zooming optical systems that can change the observation magnification of the observation subject and a left and right pair of eyepiece optical systems; a stereoscopic microscope is comprised by de-centering the center position of the light source member against the optical axis of the illumination optical system so that the luminous flux of the illumination optical system moves in the orthogonal direction against the horizontal plane that includes two observation optical axes of the zooming optical system.

Claim 2

A stereoscopic microscope, comprising: an observation optical system that includes an object lens that brings the observation subject into the focal position, a left and right pair of zooming optical systems that can change the observation magnification of the observation subject and a left and right pair of eyepiece optical systems; and an illumination optical system that includes a reflection member for leading the luminous flux from a light source member to the observation subject; and a stereoscopic microscope is comprised by a notch being arranged on the reflection member so that the luminous flux of the illumination optical system and the optical axis of the observation optical system can approach each other, and the notch is a shape contacting 1/3 or more of the outer diameter of the two luminous fluxes

of the observation optical system occurring in the free observation magnification of the zooming optical system.

Claim 3

The stereoscopic microscope described in Claim 1, wherein the illumination optical system is a zooming illumination optical system that can change the illumination field, and the illumination field of the illumination optical system can operate in conjunction with the magnification change of the zooming optical system.

Claim 4

The stereoscopic microscope described in Claim 3, wherein the illumination optical system has a reflection member to lead the luminous flux from the light source member to the observation subject, and the reflection member is arranged in the image vicinity of the light source member that is formed by the projection optical system, and the reflection member is de-centered in the opposite direction to the de-centering direction of the output plane of the light source member in the orthogonal direction to the optical axis of the projection optical system.

Claim 5

The stereoscopic microscope described in Claim 1, wherein the de-centering amount of the light source member has the ability to be selected.

Claim 6

The stereoscopic microscope described in Claim 1, wherein an optical member with a non-spherical shaped output end arranged near to the image formation point of the illumination optical system, and the light source member includes a light guide, and the output end shape of the light guide is similar to the shape of the output end of the optical member.

Claim 7

The stereoscopic microscope described in Claim 2, wherein a reflection prevention member is installed in the notch of the reflection member.

Claim 8

The stereoscopic microscope described in Claim 7, wherein the reflection prevention member is a light shielding cloth.

Claim 9

A stereoscopic microscope described in Claim 1, wherein the illumination optical system has a reflection member that leads the luminous flux from the light source member to the observation subject, and a notch is arranged on the reflection member so that the luminous flux of the illumination optical system and the optical axis of the observation optical system can approach each other, and the notch is a shape contacting 1/3 or more of the outer diameter of the two luminous fluxes of the observation optical system occurring in the free observation magnification of the zooming optical system.

Claim 10

The stereoscopic microscope described in Claim 2 or Claim 9, wherein the reflection member approaches the direction of the observation subject while approaching the optical axis of the observation optical system when the observation magnification by means of the zooming optical system approaches a high magnification.

Claim 11

The stereoscopic microscope described in Claim 2 or Claim 9, wherein the observation magnification is from 7 to 25 times.

Detailed Description of the Invention

0001

Industrial Applications

The present invention relates to a stereoscopic microscope, and more specifically, a surgical microscope.

0002

Prior Art

In recent years, many operations using a surgical microscope have been performed in order to make microscopic treatment possible in conjunction with the demand to minimize invasive surgery. Generally, surgical microscopes have an optical system built-in that provides a function for changing the observation magnification. For this reason, various treatments, such as suturing and so forth, can be performed under observation with the most appropriate magnification; for example, in a neurosurgical operation, the extraction of a tumor, the preventive treatment of abnormal progression concerning a blood vessel which is developing abnormally and so forth.

0003

Further, an operation area is not only on a flat surface, but it is common for many areas to be located in a deep area where a surgical portion must be dug down deeply, and the illumination light which illuminates the surgical portion becomes easily shielded at the hole entrance when a surgical portion is formed in an especially deep hole. Accordingly, it is preferable that the optical axis of an illuminating beam be as close as possible to the optical axis of an observation beam for observing the surgical portion in order for the illuminating beam to reach far enough into a deep area.

0004

As a result, various proposals have been given heretofore for surgical microscopes that arranges the optical axis of an illuminating beam (hereafter referred to as an illumination optical axis) for illuminating the surgical portion to approach near to the optical axis of the observation beam (hereafter referred to as the observation optical axis) for observing the surgical portion, or which arranges it so as to match the observation optical axis and the illumination optical axis.

0005

The conventional surgical microscope is made to irradiate an illuminating beam to a surgical portion from the direction where the observation optical axis and the illumination luminous flux are matched by arranging a semi-transmission semi-reflection member directly below (on the optical axis) the observation optical system, and entering an illumination luminous flux from the direction where the optical axis of the observation optical system crosses at a right angle to the semi-transmission semi-reflection member, and matches the observation optical axis and the illumination optical axis (for example, refer to the Patent Publication 1).

0006

Additionally, another conventional surgical microscope is made to irradiate an illuminating beam from two fixed directions to an observation subject in the case where a surgical portion is placed in a deep hole, by dividing it into two systems, namely, the irradiation axis of an illumination beam which is emitted from the light source integrated in the surgical microscope in order to irradiate many illumination luminous fluxes into the deep hole, together with arranging the irradiation axis of each illumination beam in a fixed manner at a lateral symmetrical position against the observation optical axis (for example, refer to the Patent Publication 2 and 3).

0007

Still another conventional surgical microscope is made to illuminate a surgical portion through an opening of a left and right pair of observation luminous fluxes, and an illumination optical system is constructed to lead an illumination flux to a surgical portion from a region which is placed upward to the object opposite surface of the objective lens through an intermediate range of a left and right pair of observation luminous fluxes corresponding respectively to both the left and right eyes of an observer (for example, refer to the Patent Documentation 4 and 5).

0008

In a surgical microscope according to Patent Publication 1, only half of the illumination beams emitted from the light source are lead to the observation subject because a semi-transmission semi-reflection member is arranged on the optical axis of the observation optical system, and also the observing brightness of an observer decrease further and the quantity of light becomes almost one quarter because the illumination luminous fluxes which are reflected by the observation subject and go towards the observation optical system again pass through the semi-transmission semi-reflection member and enter into the observation optical system. Therefore, a surgeon had to either perform an operation with a dark observation image or use an expensive high intensity light source which is capable of emitting an extremely bright quantity of light to provide the necessary light quantity for observation.

0009

In a surgical microscope according to the Patent Publications 4 and 5, the interval of the left and right observation luminous fluxes become separated widely because the left and right observation optical systems corresponding to the both left and right eyes of an observer are arranged to the left and right avoiding the illumination optical system placed in the center. Accordingly, even though the illumination fluxes reach the bottom of a deep hole, the observation luminous fluxes are shielded at the entrance edge of the hole, and the bottom of the hole is not able to be observed as well. Not only that, but even the

enlargement of the microscope itself has been attempted because the interval of the left and right observation luminous fluxes becomes widely separated.

0010

In the surgical microscope according to Patent Publication 2 and 3, an inner wall of a deep hole can be illuminated brightly compared to the case of irradiating from a single direction. However, reaching the illumination fluxes satisfactorily to a surgical portion at the bottom of a deep hole has not been achieved as well because, similar to conventional microscopes, the angle itself formed by the illumination optical axis against the observation optical axis has not changed in the slightest.

0011

Patent Publication 1

Japanese Laid-Open Patent Publication H8-257037 (Figure 1)

0012

Patent Publication 2

Issued Japanese Patent Publication No. 3011950 (Figure 2)

0013

Patent Publication 3

Japanese Laid-Open Patent Publication H10-73769 (Figure 1)

0014

Patent Publication 4

Japanese Patent Publication H6-44101 (Figure 7)

0015

Patent Publication 5

Issued Japanese Patent Publication No. 2891923 (Figure 3)

0016

Problems overcome by the invention

The present invention is achieved in view of the aforementioned conditions, and the purpose of the invention is to provide a surgical microscope that has the ability to perform favorable observation by reaching a sufficient illumination beam to a surgical portion without enlarging the scale of the microscope or loss of the illumination beam, especially even when the observer is dealing with the bottom of a deep surgical portion.

0017

Problem resolution means

The stereoscopic microscope of the present invention:

(1) comprises an illumination optical system for illuminating a luminous flux onto an observation subject from a light source member and which includes a projection optical system that forms an image one time of a luminous flux from a light source member, and an observation optical system that includes an object lens that brings the observation subject into the focal position, a left and right pair of zooming optical systems that can change the observation magnification of the observation subject and a left and right pair of eyepiece optical systems; wherein the stereoscopic microscope de-centers the center position of the light source member relative to the optical axis of the illumination optical system so that the luminous flux of the illumination optical system moves in the orthogonal direction relative

to the horizontal plane that includes two observation optical axes of the zooming optical system.

0018

According to the construction described above, the illuminating luminous flux is irradiated enabling brighter observation even if the observation subject is very deep since the optical axis of the observation optical system and the luminous flux of the illumination optical system can approach each other.

(2) Comprising an observation optical system that includes an object lens that brings the observation subject into the focal position, a left and right pair of zooming optical systems that can change the observation magnification of the observation subject and a left and right pair of eyepiece optical systems; and an illumination optical system that includes a reflection member for leading the luminous flux from a light source member to the observation subject; a stereoscopic microscope is constructed by a notch being arranged on the reflection member so that the luminous flux of the illumination optical system and the optical axis of the observation optical system can approach each other, and the notch is a shape contacting 1/3 or more of the outer diameter of the two luminous fluxes of the observation optical system occurring in the free observation magnification of the zooming optical system.

0019

According to the construction described above, the same efficacy as given above is achieved because the portion of the illuminating luminous flux that has a notch that approaches the observation optical axis. Further, since high magnification is common as the observation magnification for observing deep into an observation subject, high magnification is preferred at the time of observation over low magnification when using the aforementioned free observation magnification.

(3) The illumination optical system is characterized by the fact that it is a zooming illumination optical system that can change the illumination field, and the illumination field of the illumination optical system can operate in conjunction with the magnification change of the zooming optical system.

(4) The illumination optical system is characterized by the fact that it has a reflection member to lead the luminous flux from the light source member to the observation subject, and the reflection member is arranged in the image vicinity of the light source member that is formed by the projection optical system, and the reflection member is de-centered in the opposite direction to the de-centering direction of the output plane of the light source member in the orthogonal direction to the optical axis of the projection optical system.

(5) The de-centering amount of the light source member is characterized by the fact that it has the ability to be selected.

(6) Wherein an optical member with a non-spherical shaped output end arranged near to the image formation point of the illumination optical system, and the light source member includes a light guide, and the output end shape of the light guide is similar to the shape of the output end of the optical member.

(7) Wherein a reflection prevention member is installed to the notch of the reflection member.

(8) Wherein the reflection prevention member is a light shielding cloth.

(9) Wherein the illumination optical system has a reflection member that leads the luminous flux from the light source member to the observation subject, and a notch is arranged to the reflection member so that the luminous flux of the illumination optical system and the optical axis of the observation optical system can approach each other, and the notch is a shape contacting 1/3 or more of the outer diameter of the two luminous fluxes of the observation optical system occurring in the free observation magnification of the zooming optical system.

(10) Wherein the reflection member approaches in the direction of the observation subject while approaching the optical axis of the observation optical system when the observation magnification by means of the zooming optical system approaches a high magnification.

(11) Wherein the observation magnification is from 7 to 25 times.

[0020]

Embodiments

A description of the Embodiment of the stereoscopic microscope of the present invention is provided hereafter with reference to the Drawings.

Embodiment 1

The construction of the surgical microscope of the present Embodiment is shown in FIG. 1. The observation means of the surgical microscope should provide a parallax corresponding to both the left and right eyes of the observer, and the optical system to the rear of the object lens constitute the left and right pair of observation optical systems. However, only one side of the observation optical system is shown in FIG. 1 (a) as the drawing depicts the surgical microscope from the side.

[0021]

Reference numeral 1 shown in FIG. 1 is the object lens of the observation optical system (observation means), and this object lens 1 brings the observation subject (surgical portion) into the focal position. The object lens 1 takes the luminous flux that enters therein and exits it to the zooming lens system (zooming optical system) 3 as an afocal luminous flux. When viewing a surgical microscope such as that shown in FIG. 1 (a) from the side, the optical axis (observation optical axis L1) of the zooming lens system 3 and the object lens 1 appear that the left and right pair match with the same direct line. The zooming lens system 3 of the observation optical

system performs afocal zooming on the luminous flux that enters from the object lens 1 and exits to the eyepiece optical system 4 again as an afocal luminous flux.

0022

The eyepiece optical system 4 is constructed from the image formation lens 5 and the eyepiece lens 6. The image formation lens 5 is arranged above the optical axis L1, and the afocal luminous flux going out from the zooming lens system 3 enters therein. Image formation is performed at image formation position i by passing through the image rotator not shown in the drawing from the image formation lens 5. The eyepiece lens 6 enlarges the image formed at the image formation position i to be observed by the surgeon.

0023

The illumination optical system 7 that illuminates the surgical portion 2 is arranged orthogonally to the object optical axis as shown in FIG. 1 (a). The illumination optical system 7 is constructed from a condenser lens 8, a illumination field diaphragm 9, a variator lens 10 that can change the range of the illumination field, and an illumination lens 11 for adjusting the focal point of the image of the illumination field diaphragm obtained by the variator lens 10 to the surgical portion 2. The variator lens 10 works with the zooming action of the zooming lens system 3. The illumination lens 11 is cemented with the prism 12 for reflecting the luminous flux from the variator lens 10 to the direction of the surgical portion 2.

0024

The light source member 13 is constructed by a light source 14, a collective lens 15, and a light guide 16. The center position O of the output end of the light guide 13 de-centers in the orthogonal direction to the optical axis L2 of the illumination optical system 7 being the direction separating from the surgical portion 2 in the present

Embodiment (the direction indicated by the arrow indicator A in FIG. 1 (a)). Further, the output end shape of light guide 16 is circular such as that in FIG. 5.

[0025]

The luminous flux that goes out from the light source 14 is collected by the collective lens 15 and enters the light guide 16. The luminous flux that goes out from the light guide 16 passes in order through the condenser lens 8, the illumination field diaphragm 9, the variator lens 10, the prism 12, and then illumination lens 11 to thereafter illuminate the surgical portion 2. The illumination optical system 7 of the present Embodiment is a Koehler illumination optical system that projects the exit pupil of the light source member 13 to the surgical portion 2. Accordingly, the image of the output end of the light guide 16 is formed on the surface of the surgical portion 2 side of the illumination lens 11 by means of the condenser lens 8 and the variator lens 10 (projection optical system). Further, the image of the illumination field diaphragm 9 is formed at the surgical portion 2 by means of the variator lens 10 and the illumination lens 11.

[0026]

Since the light guide output end image is zoomed by the variator lens 10, the size of the image changes according to the illumination field range (magnification fluctuation). The state of the light guide output end image formed in the prism 12 is shown in FIG. 1 (b). The reference Imax of FIG. 1 (b) is the end image of the light guide 16 for when the illumination field range is narrow (time of a high magnification); and the reference Imin is the end image of the light guide 16 for when the illumination field range is wide (time of low magnification). Further, FIG. 10 is a general light beam drawing of the illumination optical system 7 for when the output end of the light guide 16 is not de-centered against the optical axis L2 of the illumination optical system; and FIG. 11 is a general light beam drawing of the illumination optical system 7 for when the output end of the light guide 16 is de-centered against the optical axis L2 of the illumination optical system (both Drawings omit the reflection prism 12). Both (a) and (b) of FIG.

10 and FIG. 11 show a light beam drawing at the time of low magnification (time of wide range illumination) and at the time of high magnification (time of narrow range illumination) respectively. According to FIG. 10 and FIG. 11, the change in size of the luminous flux in the vicinity of the illumination lens 11 (the output end image of the light guide 16) can be discerned between the time of low magnification and the time of high magnification. In other words, that the luminous flux of the illumination lens 11 in FIG. 11 is more de-centered against the illumination optical axis L2 than the luminous flux of the illumination lens 11 in FIG. 10 can be understood.

[0027]

Because the output end image of the light guide 16 is de-centered against the optical axis L2 of the illumination optical system, the illuminating luminous flux approaches the optical axis L1 of the observation optical system. In other words, the end image (Imax, Imin) of the light guide 16 in the orthogonal direction against the horizontal plane H1 (the plane shown by the two long and short alternating lines in FIG. 1 (b)) that includes the two observation optical axes L1 approaches the observation optical axis L1. In other words, the illuminating luminous flux approaches the observation optical axis L1. Thus, the portion of the illuminating luminous flux shielded by the edge of the entrance to the deep hole is reduced allowing the bottom of the deep hole to be illuminated. Furthermore, the surgeon is able to observe the bottom of a deep hole through the eyepiece optical system 4, the zooming lens system 3, and the object lens 1 of the observation optical system.

0028

In addition, a notch is arranged in the object lens 1 so the luminous flux P1 and P2 of the observation optical system are not eclipsed as shown in FIG. 1 (b), and since the illumination lens 11 and reflection prism 12 are arranged at the notched portion, the observation optical axis L1 and the illuminating luminous flux approach each other.

0029

Furthermore, although the illumination optical system 7 of the present Embodiment is an optical system with a variable illumination field range, it goes without saying that even an illumination optical system having a fixed illumination range would provide similar efficacy. However, there are differing effects with an illumination optical system having a variable observation field range. When the observation magnification is low, the surgeon cannot view the bottom of a deep hole well because the observation field of view is wide and is for shallow surgery over a broad area or for surgery prior to digging a deep hole. Furthermore, when the observation field of view is wide, a wide range illumination filed is required, and naturally, an absolute amount of brightness is required as the level of illumination is reduced over a wide range illumination field. For this reason, the illuminating luminous flux must not eclipse the illumination optical system. On the other hand, when the observation magnification is high, the surgeon can view the bottom of a deep hole. Furthermore, when the observation field of view is narrow, a narrow range illumination field has the ability to increase the level of illumination since the illumination field can be narrower. For this reason, a slight eclipse is allowable with the illumination optical system as conversely there is excess brightness for observation at the time of low magnification. Therefore, as shown in the present Embodiment, by de-centering the light source member 13 (output end of the light guide 16) against the optical axis L2 of the illumination optical system 7, as with the Imax and Imin of FIG. 1 (b), there is no reduction to the brightness without eclipsing by the illumination optical system 7 the time of wide range illumination (low magnification). At the time of narrow range illumination (high magnification), there is eclipsing, but the surgeon is able to observe even the bottom of a deep hole because the illuminating luminous flux approaches the optical axis L1 of the observation optical system.

[0030]

By merely de-centering the light source member 13 in this way, a surgical microscope that satisfies the demands of surgeons is made. In addition, a better microscope can be achieved if the amount of de-

centering of the output end of the light guide has the ability to change freely which can alleviate the amount of de-centering in the importance of brightness when not observing the bottom of a deep hole at the time of high magnification.

[0031]

It goes without saying that the same efficacy as the prism 12 can be achieved with a mirror also. Furthermore, the same efficacy as the light source member 13 can also be achieved with only the light source 14.

[0032]

In the present Embodiment, the prism 12 and the illumination lens 11 are cemented, which makes approaching the observation optical axis L1 possible since there is no contact slippage with a single body type. Accordingly, observation of the bottom of a deep hole is further enhanced.

Embodiment 2

The construction of a surgical microscope of the present Embodiment is shown in FIG. 2. The illumination optical system 20 of the present Embodiment is a Koehler illumination optical system the same as in Embodiment 1 and is constructed from a condenser lens 8, an illumination field diaphragm 9, a variator lens 10, and an illumination lens 11. The variator lens 10 works in conjunction with the zooming action of the zooming lens system 3. The illumination lens 11 is cemented to the prism 12 to reflect the luminous flux from the variator lens 10 to the direction of the surgical portion 2.

[0033]

The light source member 23 is constructed from a light source 24, a collective lens 25 and a light guide 26. The center position O of the output end of the light guide 26 is de-centered in the orthogonal direction against the optical axis L2 of the illumination optical

system 20 being the direction that approaches the surgical portion 2 (the direction indicated by the arrow in FIG. 2 (a)). Furthermore, the reflection prism 12 and the illumination lens 11 are de-centered in the direction separating from the surgical portion 2. Further, the output end shape of the light guide 26 is a rectangle such as that shown in FIG. 6. It is preferred that the size of this output end is nearly the same as the size of the output end image of the light guide projected at the time of high magnification by the variator lens 10 and the size of the entrance/exit surface of the prism 12 and illumination lens 11. The remaining construction is the same as Embodiment 1 and therefore the description thereof will be omitted.

[0034]

The luminous flux output from the light guide 26 undergoes image formation on the reflection prism 12 and illumination lens 11 by means of the variator lens 10, and an image is formed as shown in FIG. 2 (b). The output end image of the light guide 26 at the time of low magnification is indicated as Imin, and the output end image at the time of high magnification is indicated as Imax. For this reason, the same efficacy can be achieved as Embodiment 1 at the time of high magnification yet the illuminating luminous flux and the observation optical axis L1 can approach each other at the time of low magnification. Moreover, in Embodiment 1 the illumination optical system 7 at the time of high magnification shaded the illuminating luminous flux resulting in a loss of light, but in the present Embodiment, it is possible to efficiently illuminate the surgical portion 2 since the output end shape of the light guide is a rectangle equivalent to the transmission surface of the illumination lens 11 and the reflection prism 12, thereby enabling a surgeon to observe a deep hole brightly.

0035

With the present Embodiment, the reflection prism 12 and the illumination lens 11 are de-centered in the direction that separates from the surgical portion 2, but it goes without saying that the same efficacy can be obtained by de-centering the light guide 26, condenser

lens 8, illumination field diaphragm 9 and variator lens 10 together in the direction that approaches the surgical portion 2.

Embodiment 3

The construction of the surgical microscope of the present Embodiment is shown in FIG. 3 and FIG. 4. FIG. 3 is a descriptive drawing viewing the surgical microscope from the side in a state of observing an observation subject with low magnification; and FIG. 4 is a descriptive drawing viewing the surgical microscope from the side in a state of observing an observation subject with high magnification.

[0036]

The illumination optical system 30 of the present Embodiment is a Koehler illumination optical system the same as in Embodiment 1 and is constructed from a condenser lens 8, an illumination field diaphragm 9, a variator lens 10, an illumination lens 31 cemented to a reflection prism 32. The illumination lens 31 cemented to the reflection prism 32 is equipped with a notch so as to contact the two observation luminous fluxes P1 and P2 as shown in FIG. 3 (b) and FIG. 9.

[0037]

FIG. 9 (b) is a lateral view drawing of the illumination lens 31 cemented to the reflection prism 32; and FIG. 9 (a) is a drawing seen from the bottom side (A side); and FIG. 9 (c) is a drawing seen from the reflection side (B side). Further, the illumination lens 31 cemented to the reflection prism 32 works together with the zooming lens system of the observation optical system. When the zooming lens system 3 is in low magnification, the reflection prism 32 is arranged in a position that does not eclipse the observation luminous fluxes P1 and P2 as well as to that part of the objective lens 1 that has a notch (the orthogonal direction against the optical axis of the objective lens) as shown in FIG. 3 (a). When the zooming lens system 3 is in high magnification as shown in FIG. 4 (a), the reflection prism 32 is arranged in a position that does not eclipse observation luminous

fluxes P3 and P4 in addition to being closer to the observation optical axis L1 and to the surgical portion 2 than when in low magnification.

[0038]

Concerning the observation luminous fluxes P1 and P2 at the time of low magnification observation and the observation luminous fluxes P3 and P4 at the time of high magnification observation, as for the size of the observation luminous flux near to the object lens 1, the observation luminous fluxes P1 and P2 at the time of low magnification observation are larger. The reason being that with a general surgical microscope, the pupil position is in the middle of the zooming lens system 3, and the one at the time of low magnification observation with the wide picture angle is larger for the luminous flux near the object lens 1. Accordingly, the illumination lens 31 and the reflection prism 32 can be arranged closer to the observation optical axis at the time of high magnification observation. Also, a black cloth shaped light shielding cloth 34 for preventing the reflection of the luminous flux is attached to the notch part (D side of FIG. 9) of the illumination lens 31 and the reflection prism 32.

[0039]

The center position O of the output end of the light guide 36 de-centers in the orthogonal direction to the optical axis L2 of the illumination optical system 30 being the direction that separates from the surgical portion 2 of the present Embodiment (the direction indicated by the arrow A in FIG. 3 (a) or FIG. 4 (a)). Furthermore, it is preferred that the output end shape of the light guide 36, as shown in FIG. 7, take a similar shape to the notched transmission plane (surgical portion side of the illumination lens 31) of the reflection prism 32.

[0040]

Furthermore, a cover glass 33 is attached the bottom side of the object lens 1 at an angle against the observation optical axis in order to

prevent dust or scratches on the illumination lens 31 or the object lens 1.

[0041]

The remaining construction is the same as with Embodiment 1 and therefore the description thereof will be omitted.

The luminous flux output from the light guide 36 forms an image on the reflection prism 32 and the illumination lens 31 by means of the condenser lens 8 and the variator lens 10. For this reason, the output end image of the light guide 36 at the time of low magnification by means of the variator lens 10 the same as in Embodiment 1 is indicated by Imin in FIG. 3 (b). The output end image of the light guide 36 at the time of high magnification is eclipsed by the illumination lens 11 in Embodiment 1 and therefore has a slight loss of light. However, in the Embodiment, the output end image of the light guide 36 is not eclipsed by the illumination lens 31 as shown by the Imax in FIG. 4 (b) on account that the reflection prism 32 and the illumination lens 31 at the time of high magnification approach (de-center) to the direction of the surgical portion while approaching the observation optical axis L1.

[0042]

Since a notch is arranged to the illumination lens 31 that is cemented to the reflection prism 32, the illuminating luminous flux has the ability to approach that amount nearer to the observation optical axis L1 than in Embodiment 1. Additionally, since the illumination lens 31 cemented to the reflection prism 32 operates so as to approach the observation optical axis L1 at the time of high magnification, the illuminating luminous flux and the observation optical axis L1 can approach each other closer than in Embodiment 1. Moreover, in Embodiment 1, the illumination optical system 7 at the time of high magnification shades the illuminating luminous flux thereby causing loss of light, but with this Embodiment, the surgical portion 2 can be illuminated efficiently without loss of light thereby enabling the surgeon to observe the bottom of a deep hole with brightness.

[0043]

In addition, since a light shielding cloth is stuck to the notched part of the illumination lens 31 and the reflection prism 32, the illuminating luminous flux output from the illumination lens 31 is prevented from flaring into the observation optical path by reflecting directly off of the cover glass 33 as shown in f1 of FIG. 8 or FIG. 3 (a). Furthermore, as shown in f2 of FIG. 8 or FIG. 3 (a), this also prevents a glare from forming by reflecting off of the notch surface of the illumination lens 31 and reflection prism 32 and entering the observation light path.

[0044]

Efficacy of the Invention

According to the present invention, a stereoscopic microscope can be provided that allows a surgeon to obtain a bright observation image without eclipsing any surgical portions because illumination can be irradiated sufficiently even to the bottom of a deep hole.

Brief Description of Drawings

Figure 1 illustrates the construction of a surgical microscope according to Embodiment 1 of the present invention.

Figure 2 illustrates the construction of a surgical microscope according to Embodiment 2 of the present invention.

Figure 3 illustrates the construction of a surgical microscope according to Embodiment 3 (at the time of low magnification observation) of the present invention.

Figure 4 illustrates a construction of a surgical microscope according to Embodiment 3 (at the time of high magnification observation) of the present invention.

Figure 5 illustrates an output end shape of the light guide according to Embodiment 1 of the present invention.

Figure 6 illustrates an output end shape of the light guide according to Embodiment 2 of the present invention.

Figure 7 illustrates an output end shape of the light guide according to Embodiment 3 of the present invention.

Figure 8 illustrates an enlarged view drawing of the vicinity of the reflection prism for the illumination system and the objective lens according to Embodiment 3 of the present invention.

Figure 9 illustrates a drawing of the shape of the reflection prism for an illumination system according to Embodiment 3 of the present invention.

Figure 10 illustrates a general beam drawing of the illumination optical system in a state where the light source is non-de-centered.

Figure 11 illustrates a general beam drawing of the illumination optical system in a state where the light source is de-centered.

Explanation of referenced numerals

1	Objective lens
2	Observation subject (a surgical portion)
3	Zooming lens system
4	Eyepiece optical system
5	Image formation lens
6	Eyepiece lens
7	Illumination optical system
8	Condenser lens
9	Illumination field diaphragm
10	Variator lens
11	Illumination lens
12	Prism
13	Light source member
14	Light source
15	Collective lens
16	Light guide
H1	Flat surface
i	Image formation position
Imax, Imin	End image of light guide
L1	Observation optical axis
L2	Illumination optical axis
O	Center position of the light guide output end
P1, P2	Luminous flux of the observation optical system

Document Name Abstract

Abstract

Purpose:

To provide a surgical microscope that has the ability to perform favorable observation by reaching a sufficient illumination beam to a surgical portion without enlarging the scale of the microscope or loss of the illumination beam and especially even when the observer is treating the bottom of a deep surgical portion.

Resolution Means:

An illumination optical system 7 for illuminating a luminous flux onto an observation subject 2 from a light source member and which includes a projection optical system that form an image one time of a luminous flux from a light source member 13, and an observation optical system that includes an object lens 1 that brings the observation subject into the focal position, a left and right pair of zooming optical systems 3 that can change the observation magnification of the observation subject and a left and right pair of eyepiece optical systems 4; a stereoscopic microscope is comprised by de-centering the center position O of the light source member against the optical axis of the illumination optical system so that the luminous flux of the illumination optical system moves in an orthogonal direction against the horizontal plane that includes two observation optical axes of the zooming optical system.

Selected Drawing: FIG. 1